

Ultrasound Guided Erector Spinae Plane Block versus Local Anaesthetic Infiltration in Spine Surgeries: Intraoperative and Post-operative Analgesic Outcomes

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Abstract

Background: Spine surgeries are associated with severe postoperative pain. In this study comparative analgesic efficacy, intra-operative and post-operative outcomes were examined in ultrasound-guided erector spinae plane block (ESPB) with the combination of ropivacaine at a concentration of 0.375% with 1 µg/kg dexmedetomidine, with 20 ml of the drug injected in the plane of the lumbar surgical site versus Local Anaesthetic wound infiltration in Spine (LAWI-Group-B) surgeries with the same of drugs.

Primary outcome was postoperative pain intensity at rest using a Numeric Rating Scale (NRS) and VAS. Secondary outcomes included difference in pain intensity between pre-intervention and defined time points, total amount of opioid analgesic requested by the patients at the same time points, the incidence of any adverse event, and the length of hospital stay (LOS) after surgery. A total of Ninety patients, 45 patients in group (ESPB=Group-A, LAWI = Group B) were enrolled in the study. After surgery it was detected a NRS value of 2.4 ± 1.8 in ESPB group and 5.4 ± 1.3 in LAWI group ($P < 0.001$). VAS score and rescue analgesic doses were observed lower in Group-A as compared to group-B. Concerning LOS, 45 (100%) patients in the ESPB group and 34 (75.55%) in LAWI group were discharged after 72 hours ($P = 0.005$).

Conclusion: Ultrasound-guided ESPB offers improved postoperative analgesia compared with local infiltration in patients undergoing spinal surgery. Combination of ropivacaine (0.375%) + 1 µg/kg dexmedetomidine was found safe and effective drugs for ESPB and LAWI.

Keywords: Lumbar spinal surgeries, ultrasound-guided ESPB, Ropivacaine, dexmedetomidine, Local Anaesthetic wound infiltration in Spine (LAWI).

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Introduction

Lumbar spinal surgeries are commonly performed to treat conditions including disc herniation and spinal stenosis [1, 2]. These surgeries, although beneficial in addressing underlying spinal issues, often result in significant postoperative pain. Spinal surgeries, especially those involving instrumentation, result in significant postoperative pain due to the nature of the surgery, which disrupts both muscular and bony structures. The pain is multifactorial, involving nociceptive (surgical site), neuropathic (nerve root irritation), and inflammatory components. A multimodal analgesic approach allows clinicians to address these multiple pain pathways simultaneously, providing more comprehensive pain relief. This postoperative pain can adversely affect the recovery process, prolong hospital stays, and reduce the overall quality of life for patients [3, 4]. Therefore, effective postoperative pain

management is critical for enhancing recovery outcomes and patient satisfaction following lumbar spinal surgery [5]. Despite advancements in surgical techniques, managing postoperative pain remains a significant challenge. Traditional pain management strategies often rely heavily on opioid analgesics. Opioid use in spinal surgery is common due to the intensity of postoperative pain. However, excessive opioid use is associated with numerous side effects, delayed recovery, and increased risk of complications like opioid-induced respiratory depression. This has prompted the exploration of alternative analgesic methods that can provide effective pain relief with fewer side effects. Multimodal analgesia is a key concept in modern pain management, particularly in the context of major surgeries like spinal procedures. It involves the use of different classes of analgesics and regional techniques to target various pain

pathways, thereby reducing reliance on any single form of analgesia, especially opioids. This approach is designed to improve pain relief while minimizing the side effects associated with higher doses of opioids, such as nausea, vomiting, constipation, respiratory depression, and the risk of addiction [6].

By integrating regional techniques such as Erector Spinae Plane Block (ESPB) or Local Wound Infiltration (WI) into a multimodal regimen, clinicians can reduce total opioid consumption. For example, ESPB has demonstrated opioid-sparing effects, allowing for less reliance on systemic opioids, thus decreasing the incidence of opioid related side effects [7, 8].

Effective pain control is crucial for early mobilization, which is a key factor in enhanced recovery after surgery (ERAS) protocols. Spinal surgeries often require patients to ambulate early to prevent complications such as deep vein thrombosis (DVT) and to promote spinal healing and function. Inadequate pain control, indicated by high VAS scores, can delay mobilization and prolong hospital stays. A multimodal approach that includes regional anesthesia like ESPB or WI contributes to better pain control, which can support early mobilization, decrease hospital length of stay, and improve overall recovery outcomes.

The each analgesic method presents certain benefits and drawbacks, the ideal analgesic regimen has yet to be determined. Aiming to achieve an additive or synergistic analgesic effect by targeting different receptors in the peripheral and central pain signaling pathways [3,9], local infiltrative analgesia applied in layers of the surgical wound layers has been suggested as an appealing alternative due to its simplicity, enhanced safety, and limited cost [8,10]. A recent systematic review highlighted the clinical benefit of local anesthetic infiltration at wound closure following lumbar spine surgery by means of early pain perception, post-operative opiate requirements, and time to first analgesia request [11].

Nonetheless, the major concern remains the restricted duration of action from the use of local anesthetics as sole analgesic medications.

To address this issue, alternative agents, namely opioids, non-steroidal anti-inflammatory drugs (NSAIDs), α_2 agents, opioids, steroids, ketamine, or magnesium, have been incorporated in the process of wound infiltration to enhance postoperative pain control [5]. However, the clinical advantage of the use of adjunct drugs in local wound infiltration during lumbar surgery has not yet been conclusively proven [12,13].

Local anesthetic infiltration for spine surgery:
The surgeon injecting local anesthetics (numbing

drugs) "layer-by-layer" fashion, targeting the skin, muscles, deep tissues and other structures surrounding the spine where the surgery will take place. This numbs the area to reduce pain during the procedure and provides significant pain relief after the surgery, helping to decrease the need for opioids and potentially shorten hospital stays [14,15].

Targeted Pain Relief: The anesthetic blocks pain receptors and nerve endings in the soft tissues and around the surgical wound, from the skin down to the dura (the spinal meninges).

Effective for Awake Patients: This method is particularly useful in endoscopic lumbar discectomy where the patient is awake, as the patient's feedback can help the surgeon avoid vital structures.

Benefits of Local Anesthetic Infiltration:

- **Reduced Postoperative Pain:** It is a simple and effective technique for managing pain immediately after the surgery.
- **Decreased Opioid Use:** By providing local pain control, the technique can significantly lower the amount of opioid painkillers needed post-surgery.
- **Potentially Shorter Hospital Stays:** Reduced pain and opioid use may contribute to shorter hospitalizations.
- **Cost-Effective:** This method is generally less expensive than other forms of anesthesia.

Common Anesthetics Used: [21-56]

- Bupivacaine is a common choice for local anesthetic infiltration due to its effectiveness and duration of action.
- Lidocaine is another widely used local anesthetic for its quick onset.

Methods of Infiltration

Two methods of infiltration can be performed, both with the aim to infiltrate subcutaneously:

Static – Insert the needle, aspirate to ensure no flashback of blood, then inject

Continuous – Insert the needle, inject continuously into the surrounding area with continuous movement

Aim to penetrate the skin as little number of times as possible. Rotate the angle of the needle to allow maximal infiltration through one puncture site. If required, additional punctures should be through an area already infiltrated.

Prior to any procedure, check that the area has been anaesthetised adequately by checking sensation, such as by pinching gently using toothed forceps.

*Inadvertent injection of local anaesthetic into the circulation can lead to paraesthesia, light-headedness, cardiac arrhythmias, and even cardiac arrest

Maximum Dosage of Local Anaesthetic: It is very important to know the safe dosage of local anaesthetic. The table-1 below is a guide for adults with references.

Table 1: Relationship between local anesthetic volume and diffusion level.[21-56]

(Refs.)	Year	Experimental sample type	Local anesthetic	Capacity (one side)	Blocking site	Diffusion level	Capacity/ number of segments
Tulgar and Senturk (50)	2018	Patient	Bupivacaine 0.25% + lidocaine 0.3%	30 ml	L4	T12-L4	6
Chung and Kim (51)	2018	Patient	5 ml 2% lidocaine and 15 ml contrast medium	20 ml	L4	L2-S1	4
De Lara González <i>et al</i> (47)	2019	Corpse	Contrast medium	20 ml	L4	L2-L5	5
Mantuani <i>et al</i> (52)	2019	Patient	20 ml of 1% lidocaine containing adrenaline	20 ml	L1	T10-L2	4
Celik <i>et al</i> (53)	2019	Patient	40 ml injection, including 20 ml bupivacaine, 10 ml lidocaine, 8.6 ml physiological saline, 40 mg/ml methylprednisolone, 1 ml, and 0.4 ml contrast agent	40 ml	L4	L1-S4	4.4
Ahiskalioglu <i>et al</i> (54)	2020	Patient	20 ml 0.5% bupivacaine, 10 ml 2% lidocaine, and 10 ml physiological saline	20 ml	L4	L2-L5	5
Breidenbach <i>et al</i> (55)	2023	Corpse	1 ml methylene blue and 19 ml 0.25% bupivacaine	20 ml	L4	L2-S1	4
Zhang <i>et al</i> (56)	2021	Patient	20 ml 0.4% ropivacaine	20 ml	L3	L1-L5	4
Yi-Han <i>et al</i> (21)	2022	Patient	20 ml 0.375% ropivacaine and 20 ml dexmedetomidine	20 ml	L3	L1-L5	4

Ropivacaine: (S)-ropivacaine is a piperidinecarboxamide-based amidetype local anaesthetic (amide caine) in which (S)-N-propylpiperidic acid and 2,6-dimethylaniline are combined to form the amide bond. Ropivacaine is an aminoamide local anesthetic drug marketed by Astra Zeneca under the trade name Naropin. It exists as a racemate of

its S- and R-enantiomers, although the marketed form is supplied only as the purified S-enantiomer [23].

Chemical Formula: $C_{17}H_{29}ClN_2O_2$ [(2S)-N-(2,6-dimethylphenyl)-1-propylpiperidine-2-carboxamide]

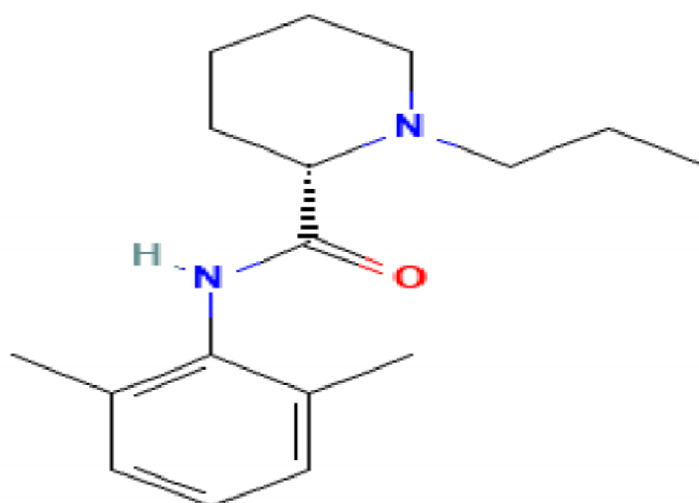


Chart 1: Chemical Structure:

It is one of the recently synthesized long-acting local anaesthetic which belongs to the amide group. It mediates its effects via the blockade of sodium channels. When compared to Bupivacaine, it is less lipophilic and hence it is associated with minimal cardio vascular and central nervous system effects [23].

A study advocated that the full-endoscopic lumbar discectomy under local anesthesia is major trends for the treatment of lumbar disc herniation in spine minimally invasive surgery but sometimes local anesthesia is not enough for analgesic in surgery especially in interlaminar approach. This study summarized the current study of anesthesia methods in full-endoscopic lumbar discectomy. Local anesthesia is still the most common anesthesia method in full-endoscopic lumbar discectomy and the comparison group for other anesthesia methods due to high safety.

This study also advocated the comparison of local anesthesia with others. It was concluded as the epidural anesthesia was less applied in full-endoscopic lumbar discectomy but reports better intraoperative pain control and equivalent safety due to the motor preservation and pain block characteristic of ropivacaine. General anesthesia can achieve totally pain block during surgery but nerve injury cannot be ignored, and intraoperative neuromonitoring can assist. Regional anesthesia application was rare but also reports better anesthesia effects during surgery and equivalent safety. Anesthesia methods for full-endoscopic lumbar discectomy should be based on patient factors, surgical factors, and anesthesiologist factors to achieve satisfactory anesthesia experience and successful surgery [16].

A database search was conducted to identify randomized controlled trials (RCTs) pertinent to wound infiltration with analgesics or miscellaneous drugs adjunctive to LAs compared with sole LAs or placebo. The outcomes of interest were postoperative rescue analgesic consumption, pain intensity, time to first analgesic request, and the occurrence of adverse events. Twelve double-blind RCTs enrolling 925 patients were selected for qualitative analysis. Most studies were of moderate-to-good methodological quality. Dexmedetomidine reduced analgesic requirements and pain intensity within 24 h postoperatively, while prolonged pain relief was reported by one RCT involving adjunctive clonidine. Data on local magnesium seem promising yet difficult to interpret. No clear analgesic superiority could be attributed to steroids. Tramadol co-infiltration was equally effective as sole tramadol but superior to LAs. No serious adverse events were reported. Due to methodological inconsistencies and lack of robust data, no definite conclusions could be drawn on the analgesic effect of local infiltrates in patients

undergoing lumbar surgery. The probable positive analgesic efficacy of adjunctive dexmedetomidine and magnesium needs further evaluation [17].

A study conducted in sixty-one patients who underwent ALIF surgery were enrolled. For thirtyone of them, a continuous local anesthetics infiltration system was used at the abdominal site. Collected data regarding the patients' sleep quality; satisfaction with pain control after surgery; abilities to perform physical tasks and the additional application of opioids in the postoperative 48 hours. The On-Q system group showed reduced visual analogue scale scores for pain at the surgical site during rest and movement at 0, 12, 24, and 48 hours; and more was satisfied with pain control management at the first postoperative day (7.0 ± 1.2 vs. 6.0 ± 1.4 ; $P = 0.003$) and week (8.1 ± 1.6 vs. 7.0 ± 1.8 ; $P = 0.010$) than the control group. The number of additional patient-controlled analgesia (PCA) bolus and pethidine injections was lower in the On-Q group (PCA: 3.67 ± 1.35 vs. 4.60 ± 1.88 ; $P = 0.049$ and pethidine: 2.09 ± 1.07 vs. 2.73 ± 1.38 ; $P = 0.032$). Patients who used the On-Q system performed more diverse activity and achieved earlier ambulation than those in the control group. The study was concluded as continuous wound infiltration with ropivacaine using an On-Q system may be effective for controlling postoperative pain after ALIF surgery [18].

A Prospective, randomised, double blind study, include 40 patients, scheduled for elective lumbar laminectomy under general anaesthesia were enrolled and randomly allocated into two groups namely Group R (n=20 receiving 20ml of 0.25% ropivacaine) and Group N (n=20 receiving 20ml normal saline) as instillation over incision site. If the NRS exceeded '4' at any point of time, rescue analgesia with inj. Diclofenac 75 mg deep intramuscular was administered. Post-operative pain score, duration of analgesia and total rescue analgesic required in 24 h were compared between the groups. Results: The pain score was less in ropivacaine group as compared to normal saline group (p value 0.0001). Duration of analgesia in normal saline group (N) is 4.3 ± 1.03 and in ropivacaine group (R) is 12.15 ± 1.49 . Mean amount of rescue analgesic required in normal saline group was 191.25 ± 38.28 mg and in ropivacaine group was 97.5 ± 35.26 mg. The study was concluded as the patients who received ropivacaine wound instillation had better pain control, longer duration of analgesia and less analgesic requirement as compared to patients who received normal saline wound instillation [19].

In a retrospective study, in 76 patients undergoing spine surgery for thoracolumbar junction fracture, 20 ml of ropivacaine 7.5% (n R group = 38) was infiltrated using a systematic technique, or no

infiltration was realized (n M group = 38). We assessed postoperative pain with Visual Analogue Scale (VAS) and morphine consumption in the 24 first hours. VAS pain score upon awakening and at 2 hours postoperatively were significantly lower in the ropivacaine group ($P = 0.01$ and $P = 0.002$). Rescue opioid requirement during the 24 first hours were about 50% lower in the ropivacaine group ($P = 0.01$). No local or systemic side effects were observed. The study concluded as the intraoperative LIA with ropivacaine in thoracolumbar junction fracture surgery may have an analgesic effect in postoperative pain control (24 hours) with a reduction of VAS and morphine consumption [20].

In a study a total of Twenty-four patients, which undergoing elective lumbar arthrodesis were randomly divided into two groups. Control group received 0.375 % ropivacaine 40 ml through the wound, and ESPB group received preoperative bilateral ESPB with 0.375 % ropivacaine 40 ml. The primary outcome was postoperative pain intensity at rest using a Numeric Rating Scale (NRS). Secondary outcomes included difference in pain intensity between pre-intervention and defined timepoints, total amount of opioid analgesic requested by the patients at the same timepoints, the incidence of any adverse event, and the length of hospital stay (LOS) after surgery. After surgery it was detected a NRS value of 1.9 ± 1.6 in ESPB group and 6.0 ± 1.7 in Control group ($p < 0.05$). In the ESPB group we found a significant decrease (from 6.3 ± 1.6 to 1.9 ± 1.7) of NRS score after surgery compared to pre-surgery values. About the opioid consumption we found a total sufentanil tablets consumption of 17 ± 9 and 10 ± 2 at 48h for Control group and ESPB group, respectively. Concerning LOS all patients in the Control group and 9 of the ESPB group were discharged after 72 hours; 3 patients in the ESPB group left the ward after 48 hours. The study was concluded as the Bilateral ultrasound-guided ESPB offers improved postoperative analgesia compared with local infiltration in patients undergoing lumbar spinal surgery [21].

In view of above facts and to the best of knowledge a few studies have been reported in abroad on comparative analgesic efficacy, intra-operative and post-operative outcomes in ultrasound-guided erector spinae plane block (ESPB) using combination of ropivacaine (0.375%) with 1 µg/kg dexmedetomidine, injected in the plane of the lumbar surgical site versus Local Anaesthetic wound infiltration in Spine (LAWI) surgeries using same combination drugs. Therefore, this study was carried out to compare the analgesic efficacy, intra-operative and post-operative outcomes in ultrasound-guided erector spinae plane block (ESPB, Group-A) with the combination of

ropivacaine at a concentration of 0.375% with 1 µg/kg dexmedetomidine, with 20 ml of the drug injected in the plane of the lumbar surgical site versus Local Anaesthetic wound infiltration in Spine (LAWI-Group-B) surgeries with the same of drugs in the patients of rural North Indian Population.

Materials and Methods

Materials:

Study Site: The study was conducted at OT-Complex, Prasad Institute of Medical Sciences, Junab Ganj, Sarai Sahjadi, Banthra, Lucknow, and Uttar Pradesh, India.

Study Design: Randomized comparative prospective study.

Study Period: 24 Months, January 2023 to January 2025, after obtaining approval from institutional ethical committee.

Study population: Patients undergone elective lumbar Spine surgeries.

Sample Size: 90 patients (45 patients in each group)

A power analysis was conducted to determine the appropriate sample size for the study. The analysis was based on detecting a clinically significant difference in the VAS and Numeric Rating Scale (NRS) score between the two groups. Assuming a mean difference of 1.5 points in the VAS score with a standard deviation of 2.0, an alpha level of 0.05, and a power of 90%, the required sample size was calculated as follows:

$$n = \left(\frac{Z_{\alpha/2} + Z_{\beta} \cdot \sigma}{\Delta} \right)^2$$

Where: The analysis revealed an effect size of 0.59 (within a 95% confidence interval) and a power of 0.99 at the significance level, suggesting that 90 volunteers were adequate for the study's sample size.

- n = required sample size per group
- $Z_{\alpha/2}$ = Z value for the desired confidence level (1.96 for 95% confidence)
- Z_{β} = Z-value for the desired power (0.99 for 90% power)
- σ = standard deviation (2.0)
- Δ = mean difference to be detected (1.5)

To account for potential dropouts and incomplete data, It was aimed to enroll 45 patients per group, resulting in a total sample size of 90 participants.

Inclusion Criteria:

1. Age group 18-70 years
2. ASA [American Society of Anaesthesiologists] physical status I, II of both sexes.
3. Elective surgery of lumbar spine.
4. Patient who gave written informed consent was included in this study.

Exclusion Criteria:

1. ASA III, IV patients
2. Known allergies to local anesthetics
3. Coagulopathy or anticoagulant therapy
4. Infection at the injection site
5. Preexisting neurological disorders affecting sensory perception
6. Pregnancy
7. Inability to understand the visual analog scale (VAS)/NRS for pain assessment
8. Psychiatric illness
9. Patient refusal, allergy to Ropivacaine
10. Not meeting the inclusion criteria

Randomization: A computer-generated random number sequence was used for randomization via IBM, SPSS version 26.1 to allocate participants into either the ESPB group (ESPB-Group-A) or the Local Anaesthetic wound infiltration in Spine group (LAWI-Group-B) to ensure that each participant had an equal chance of being assigned to either group.

This method minimized selection bias and enhanced the internal validity of the study.

Allocation concealment: The randomization process was concealed through the use of sealed, opaque envelopes, which were opened just before the intervention. This technique ensured that neither the participants nor the outcome assessors were aware of the group assignments before the intervention.

Methods:**Interventions:**

Erector spinae plane block (Group-A): ESPB was administered on L2-3 level preoperatively under ultrasound guidance via a high-frequency linear probe (Sonosite M-Turbo, Fujifilm Sonosite-Inc., USA) bilaterally.

The following safety measures were implemented to ensure accurate and safe execution of the block:

1. Patient Positioning: Patients were placed in the lateral decubitus position, which provides better access to the lumbar area and facilitates safe needle insertion. The surgical side was kept uppermost to optimize visibility and access.

2. Ultrasound Setup: A high-frequency linear ultrasound probe was used to identify the relevant anatomical landmarks, specifically the transverse processes of the lumbar vertebrae at the level of surgery. The probe was positioned in a parasagittal orientation to visualize the transverse process and surrounding muscles, ensuring clear identification of the injection site.

3. Needle Insertion:

- A 22-gauge, 100-mm needle (Stimuplex® A, B. Braun Melsungen AG, Germany) was inserted in-plane with the ultrasound probe. The in-plane technique was employed to allow continuous visualization of the needle tip throughout the procedure, reducing the risk of accidental injury to nearby structures.
- The needle was advanced cautiously until the tip made contact with the transverse process, confirming proper placement.
- Safety Check (Aspiration): After the needle reached the correct position, negative aspiration was performed to confirm that the needle was not within a blood vessel, reducing the risk of intravascular injection.

1. Injection: Once the needle was correctly positioned, 20 mL of 0.375% Ropivacaine + 1µg/kg dexmedetomidine was injected incrementally, with real-time ultrasound guidance to confirm the spread of the local anesthetic around the target area. Visualization of the anesthetic spread ensured that the drug was delivered to the correct plane, maximizing analgesic efficacy while minimizing the risk of complications.

2. Monitoring: Patients were monitored closely for any signs of complications, such as local anesthetic systemic toxicity (LAST), which can occur with regional blocks if the anesthetic is injected intravascularly. Monitoring included continuous cardiovascular and respiratory assessment during and after the procedure.

The use of ultrasound guidance is a crucial safety measure in ESPB, as it allows for real-time visualization of the needle and surrounding anatomical structures, thereby reducing the risk of nerve injury, vascular puncture, and other complications. The in-plane needle insertion technique further enhances safety by ensuring that the entire needle pathway is visible during the procedure. These precautions are especially important for lumbar spinal surgeries where delicate structures are in close proximity.

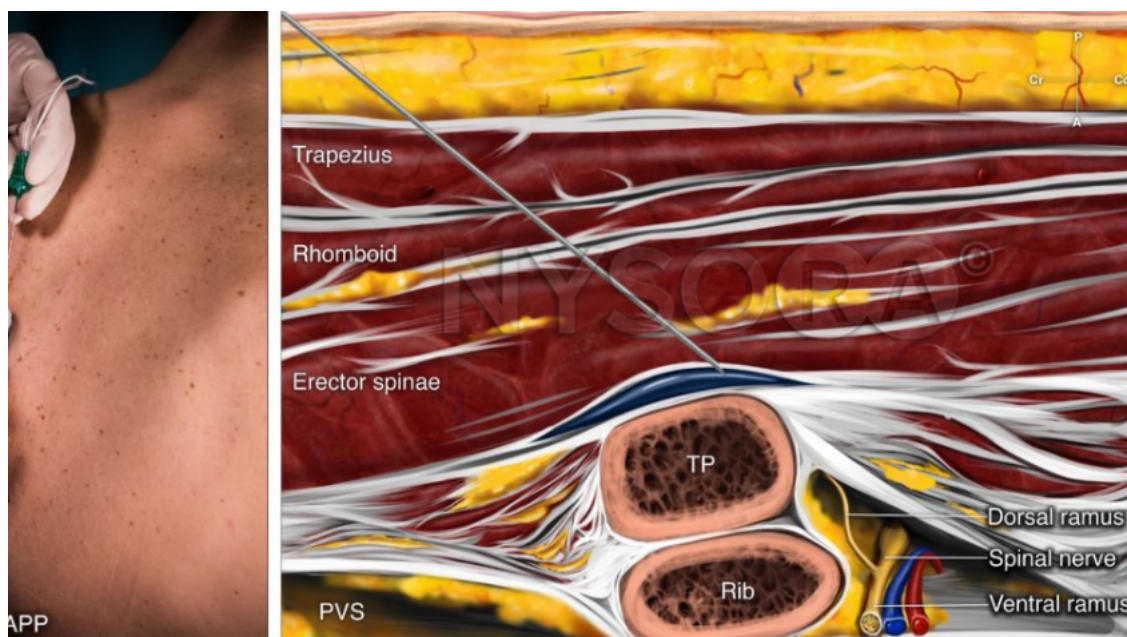


Figure 1: Ultrasound Guided-ESPB



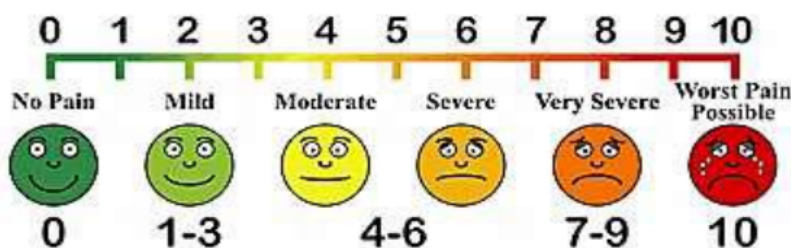
Figure 2: Ultrasound image of erector spinae plane block (ESPB)

Local Anaesthetic Wound infiltration in Spine (LAWI-Group-B): Wound infiltration was performed by the surgeon at the end of the surgery via the following procedure:

1. Preparation: After hemostasis was achieved and before skin closure, 20 mL of 0.375% Ropivacaine and 1µg/kg dexmedetomidine was prepared in a sterile syringe.
2. For infiltration, the anesthetic mixture was infiltrated into multiple layers of the surgical

wound. This included the subcutaneous tissue and muscle layers, ensuring the even distribution of the anesthetic solution to cover the entire surgical area.

Parameters studied include intraoperative, postoperative hemodynamics, onset of sensory and motor block, and duration of block, any complication, intraoperative, postoperative VAS/NRS score, time for postoperative demand (rescue) analgesia and no of analgesia required in 24 hours.



VAS Score:

The pulse rate, blood pressure, ECG, oxygen saturation (SpO₂) and respiratory rate were noted at 0 minute, thereafter every 5 minutes for the initial 15 minutes, then every 30 minutes till 3 hrs, then every hourly up to 2 hours and then every 2 hourly up to 16 hours in post-operative period. Visual Analogue Score (VAS) and Numeric Rating Scale (NRS) were measured every hour after the end of surgery for first 12 hrs. Inj. diclofenac sodium 1.5 mg/kg IV was administered when VAS ≥ 4 and time for first rescue analgesia was noted. This study was primarily compared the efficacy of supraclavicular block in both the groups in terms of the Duration of sensory block and Motor block, quality of analgesia, complications, total duration of analgesia.

Statistical Analysis: Continuous variables are presented as the means $\pm$ standard deviations and were analyzed via Student's t test for normally

distributed data or the Mann-Whitney U test for non-normally distributed data. Categorical variables are presented as frequencies and percentages and were analyzed via the chi-square test or Fisher's exact test, as appropriate. A p value of <0.05 was considered to indicate statistical significance. All the statistical analyses were performed via SPSS, version 26.1 (IBM Corp., Armonk, NY, USA).

Results

This study included a total of 90 patients, aged 18-70 years of both sexes, with 45 patients in the ESP block group (ESPB-Group-A) and 45 patients in the Local Anaesthetic wound infiltration group (LAWI-Group-B). The demographic and clinical characteristics of the participants were summarized in Table-2. There were no significant differences between the groups in terms of sex, age, or body mass index (BMI).

Table 2: The demographic and clinical characteristics of the participants

Parameters		ESPB (Group-A) n=45		LAWI(Group-B) n=45		P Value
		Male n=17	Female n=28	Male n=18	Female n=27	
Age (Years)	18-30	1(2.22%)	2 (4.44%)	2 (4.44%)	1 (2.22%)	0.523
	31- 45	2 (4.44%)	3 (6.66%)	2 (4.44%)	4 (8.88%)	0.023
	46-55	10(22.22%)	14 (31.11%)	8(17.77%)	13 (28.88%)	0.313
	56-65	3 (6.66%)	6 (13.33%)	4 (8.88%)	7 (15.55%)	0.621
	66-70	1(2.22%)	3 (6.66%)	2 (4.44%)	2 (4.44%)	0.611
Mean age $\pm$ SD	43-65 Y (Range)	54.21 $\pm$ 7.4	52.98 $\pm$ 3.9	55.61 $\pm$ 2.1	53.34 $\pm$ 4.1	0.374
ASA-Grade	G-I	19 (42.22%)		18 (40.00%)		0.441
	G-II	26 (57.77%)		27 (60.00%)		
BMI(Mean $\pm$ SD)	22.84-30.21 (Range)	22.08 $\pm$ 2.53	22.46 $\pm$ 1.77	21.98 $\pm$ 2.21	22.83 $\pm$ 2.38	0.621
Weight(Kg)	60-73 Kg	67.14 $\pm$ 5.86	68.22 $\pm$ 4.5	66.92 $\pm$ 4.66	69.86 $\pm$ 63	0.706

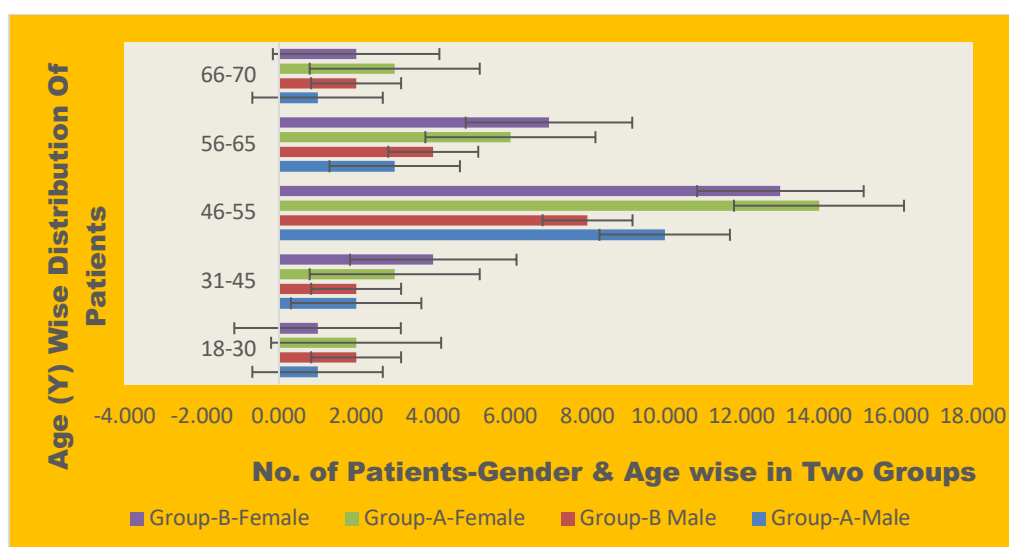


Figure 3: Age (Y) and Gender Wise Distribution of Patients in Two Groups

Demographic data of the patients such as BMI (P= 0.621), weight (P = 0.706), and ASA status (P = 0.441) were comparable in both the groups. Distribution of mean pulse rate at 45-min, 60-min,

90-min, 2-h, and 3-h post-incision was significantly lower in Group A compared to Group B. The distribution of mean systolic BP at (Group-B) infiltration and at incision (Group A) was

significantly higher in Group B compared to Group A. The distribution of mean arterial pressure (MAP) at (Gr.B) infiltration, at the incision and 2-h post-incision was significantly higher in Group-B compared to Group A. The distribution of mean pain score (NRS) at 4-h, 6-h, and 12-h post incision is significantly lower ($P = 0.007$, $P = 0.001$, $P = 0.005$, respectively) in Group A compared to Group B. In Group-B, all patients required dexmedetomidine intra-operatively; but in Group

A, only two patients required dexmedetomidine intra-operatively. The requirement of intra-operative dexmedetomidine among the patients studied was significantly lower ($P = 0.001$) in Group A compared to Group B. The mean $\pm$ SD of total doses of postoperative analgesia in Group B and Group A was 1.73 ± 0.47 and 2.32 ± 0.97 , respectively. The distribution of mean total doses of post-operative analgesia was significantly lower in Group A compared to Group B [$P = 0.001$].

Table 3: Inter-group comparison of mean pain score (NRS). NRS: Numeric rating score

Intra-Group Mean Pain Score (NRS)	ESPB (Group-A) n=45	LAWI(Group-B) n=45	Inter-group P Value
Baseline (min) Mean $\pm$ SD	0.00	0.00	0.0
1 hrs. Mean $\pm$ SD	2.6 $\pm$ 0. 23	2.9 $\pm$ 0.26	0.043
3 hrs. Mean $\pm$ SD	1.9 $\pm$ 0. 42	2.1 $\pm$ 0. 41	0.032
4 hrs. Mean $\pm$ SD	1.92 $\pm$ 0. 66	2.97 $\pm$ 0. 46	0.041
6 hrs. Mean $\pm$ SD	1.94 $\pm$ 2. 22	2.43 $\pm$ 0. 57	0.022
12 hrs. Mean $\pm$ SD	1.95 $\pm$ 2. 22	2.01 $\pm$ 0. 33	0.05
24 hrs. Mean $\pm$ SD	1.85 $\pm$ 0. 53	1.86 $\pm$ 0. 61	0.05

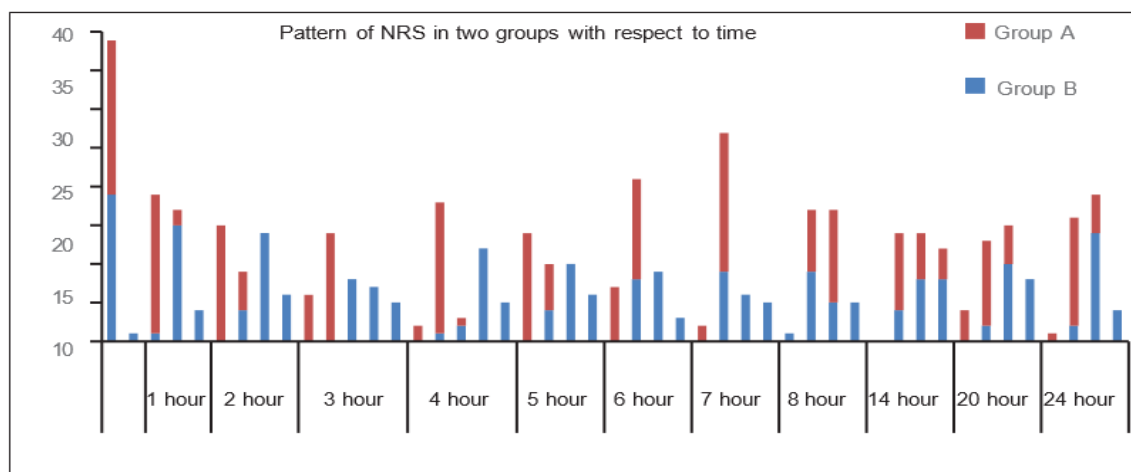


Figure 4: Bar diagram showing pattern of numerical rating scale with time

Figure-4, showing the pattern of NRS pain scores in both groups with respect to time. Mean pain scores as depicted by AUC for NRS was less in the group-A when compared with group-B

Table 4: Postoperative Numeric Rating Scale (NRS) Score Over 24 hr.

Time	Group A (n=45)	Group B (n=45)	P
30 min	3 (2-3)	5 (3-7)	0.000*
1 h	2 (0-2)	5 (4-5)	0.000*
2 h	2 (0-2)	3 (2.5-3.5)	0.000*
3 h	0 (0-2)	3 (2-3)	0.000*
4 h	0 (0-2)	3 (2-3)	0.000*
5 h	0 (0-2)	3 (2-3)	0.000*
6 h	2 (0-2)	3 (2-3)	0.000*
8 h	2 (2-3)	5 (4-5)	0.000*
12 h	4 (3-4)	3 (2-4.5)	0.173
16 h	3 (3-3)	3 (3-4)	0.158
20 h	3 (3-4)	3 (3-4)	0.275
24 h	3 (2-3)	3 (3-3)	0.297

Data presented as median (interquartile range); Median compared using Mann-Whitney U-test; * $P < 0.05$

Table 5: The American Society of Anesthesiologists (ASA) physical status and surgical duration

Variables	ESPB (Group-A) n=45	LAWI(Group-B) n=45	P Value
ASA Mean $\pm$ SD	237 $\pm$ 0.51	224 $\pm$ 0.98	0.041
ASA Range	1-3	1-3	
1	5	6	0.032
2	24	26	0.020
3	16	13	0.012
Surgical Duration Mean $\pm$ SD	394 $\pm$ 1.32	374 $\pm$ 1.11	0.014
Surgical Duration Range	2-7	2-7	

Table 6: Postoperative Analgesia Requirement:

Parameters	Group A (n=45)	Group B (n=45)	P
Time to first rescue analgesia, h*	12 (12-12)	0.8 (0.5-1)	0.000 $\ddagger$
Total tramadol requirement in 24 h, mg*	100 (50-100)	150 (100-150)	0.000 $\ddagger$
Number of patients requiring second analgesia, n (%) $\dagger$	6 (13.33)	33 (73.33)	0.000 $\ddagger$
Total paracetamol requirement in 24 h, g*	1 (0-1)	2 (2-2)	0.000 $\ddagger$

Data presented as *median (interquartile range) or $\dagger$ number of patients (percentage), Median compared using Mann-Whitney U-test and proportions compared using Chi-square test. $\ddagger$ P<0.05

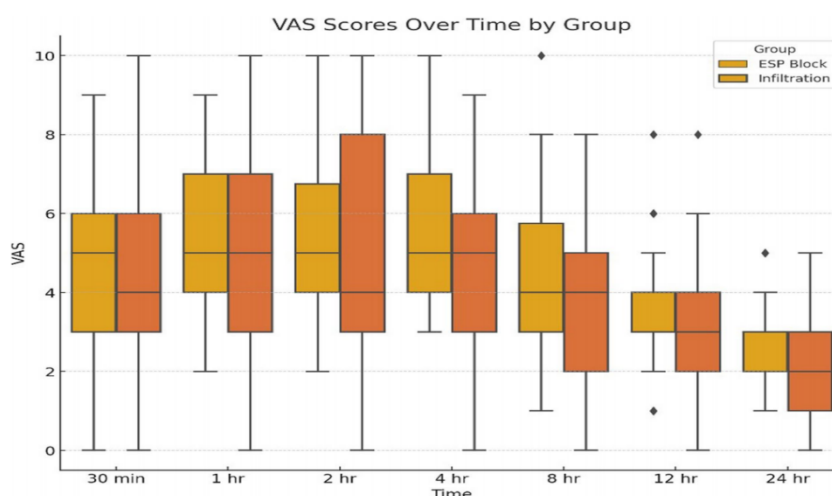
Table 7: Total duration of analgesia and rescue analgesic requirement between the two groups.

Variables	ESPB (Group-A) n=45	LAWI(Group-B) n=45	P Value
Total Duration of Analgesia Post-Surgery (min)	88 $\pm$ 10.43	53.23 $\pm$ 9.77	0.016
Rescue Analgesic Requirement (Paracetamol in Grams)	0.44 $\pm$ 0.81	0.98 $\pm$ 1.74	0.041

Table 8: Comparison of Post Operative Pain Scores (mean VAS scores) between groups

Time Point	ESPB (Group-A) n=45	LAWI(Group-B) n=45	Intergroup P Value
VAS 30 min Mean $\pm$ SD	438 $\pm$ 2. 41	510 $\pm$ 2.58	0.003
VAS 1 hr. Mean $\pm$ SD	478 $\pm$ 2. 77	576 $\pm$ 2.89	0.042
VAS 2 hr. Mean $\pm$ SD	493 $\pm$ 2. 52	580 $\pm$ 2.44	0.012
VAS 4 hr. Mean $\pm$ SD	444 $\pm$ 2.32	510 $\pm$ 2.23	0.020
VAS 8 hr. Mean $\pm$ SD	412 $\pm$ 2. 06	421 $\pm$ 2.14	0.012
VAS 12 hr. Mean $\pm$ SD	308 $\pm$ 1. 91	350 $\pm$ 2.11	0.044
VAS 24 hr. Mean $\pm$ SD	230 $\pm$ 2. 22	264 $\pm$ 1.96	0.046

The intragroup p values for changes in VAS scores over time were significant for both groups (p=0.0001), indicating significant reductions in pain scores over the 24-h post-operative period.

**Figure 5: Vas scores over time by group**

Post-operative pain scores: Postoperative pain intensity was assessed via the visual analog scale (VAS) at various time points. The results, summarized in Table-8, revealed that there were statistically significant differences in the mean VAS scores between the ESP block (Gr.A) and wound infiltration groups (Gr.B) at any of the assessed time points (30 min, 1 h, 2 h, 4 h, 8 h, 12

h, and 24 h post-operatively). These findings suggested that both analgesic techniques were not similarly effective in managing post-operative pain during the first 24 h. The VAS scores in groups B was relatively high, with mean scores $> 4.22 \pm 0.58$ at several time points, which suggested that pain management may have been inadequate during certain post-operative periods for group B.

Table 9: Inter-group comparison of mean pulse rate

Mean Pulse Rate	ESPB (Group-A) n=45	LAWI(Group-B) n=45	Intergroup P Value
Baseline (min) Mean $\pm$ SD	80.66 $\pm$ 2. 41	78.32 $\pm$ 2.58	0.301
0 min. Mean $\pm$ SD	78 $\pm$ 2. 17	76 $\pm$ 2.82	0.340
15 min. Mean $\pm$ SD	73 $\pm$ 2. 50	80 $\pm$ 2.45	0.312
30min. Mean $\pm$ SD	74 $\pm$ 2.32	75 $\pm$ 2.23	0.320
45min. Mean $\pm$ SD	72 $\pm$ 2. 06	71 $\pm$ 2.11	0.712
60min. Mean $\pm$ SD	76 $\pm$ 1. 91	69 $\pm$ 2.11	0.264
90 min. Mean $\pm$ SD	75 $\pm$ 2. 22	68 $\pm$ 1.96	0.346
2 hrs.Mean $\pm$ SD	78 $\pm$ 2. 22	65 $\pm$ 2. 41	0.361
3 hrs.Mean $\pm$ SD	79 $\pm$ 2. 22	66 $\pm$ 2. 32	0.452

Table 10: Inter-group comparison of the mean of mean arterial pressure.

Mean Arterial Pressure (mmHg)	ESPB (Group-A) n=45	LAWI(Group-B) n=45	Intergroup P Value
Baseline (min) Mean $\pm$ SD	89.66 $\pm$ 1. 66	91.32 $\pm$ 1.57	0.301
0 min. Mean $\pm$ SD	90.23 $\pm$ 1. 17	87.44 $\pm$ 1.81	0.340
15 min. Mean $\pm$ SD	84.98 $\pm$ 1. 50	88.65 $\pm$ 1.42	0.312
30min. Mean $\pm$ SD	83.71 $\pm$ 1.32	82.99 $\pm$ 1.28	0.420
45min. Mean $\pm$ SD	81.75 $\pm$ 2. 06	79.43 $\pm$ 1.16	0.612
60min. Mean $\pm$ SD	81.23 $\pm$ 1. 91	82.03 $\pm$ 1.71	0.364
90 min. Mean $\pm$ SD	84 $\pm$ 2. 22	82 $\pm$ 1.26	0.446
2 hrs.Mean $\pm$ SD	88 $\pm$ 2. 22	85 $\pm$ 2. 41	0.362
3 hrs.Mean $\pm$ SD	88 $\pm$ 2. 22	90 $\pm$ 2. 32	0.551

Table- 11: Inter-group comparison of mean total doses of analgesics

Intra-Group Mean Total Doses of Analgesic	ESPB (Group-A) n=45	LAWI(Group-B) n=45	Intergroup P Value
6 hrs.Mean $\pm$ SD	1.13 $\pm$ 0.32	2.76 $\pm$ 0.84	0.001
12 hrs.Mean $\pm$ SD	1.00 $\pm$ 0.32	1.98 $\pm$ 0.76	0.001
18 hrs.Mean $\pm$ SD	0.19 $\pm$ 0.11	0.53 $\pm$ 0.49	0.00

Comparison of the post-operative outcomes between the groups

Table 12A: The presentation of pain

Severity of Pain	ESPB (Group-A) n=45	LAWI(Group-B) n=45	Intergroup P Value
VAS Abdomen & Resting Mean $\pm$ SD			
Pre-Operative, Mean $\pm$ SD	0.00	0.00	0.042
Post-Operative, Mean $\pm$ SD	3.9 $\pm$ 1. 42	5.1 $\pm$ 2. 41	0.001
Post-12 hrs.Mean $\pm$ SD	2.92 $\pm$ 1. 66	4.97 $\pm$ 2. 46	0.001
Post-24 hrs.Mean $\pm$ SD	1.94 $\pm$ 1. 02	3.43 $\pm$ 1. 87	0.001
Post-48 hrs.Mean $\pm$ SD	1.75 $\pm$ 1. 11	2.01 $\pm$ 1. 31	0.033
Post-1 Wk.Mean $\pm$ SD	1.35 $\pm$ 1. 21	1.86 $\pm$ 1. 66	0.042
VAS Abdomen & Activation Mean $\pm$ SD			
Pre-Operative, Mean $\pm$ SD	0.00	0.00	0.039
Post-Operative, Mean $\pm$ SD	4.9 $\pm$ 1. 42	6.1 $\pm$ 2. 41	0.001
Post-12 hrs.Mean $\pm$ SD	3.92 $\pm$ 1. 16	5.97 $\pm$ 2. 46	0.001
Post-24 hrs.Mean $\pm$ SD	2.24 $\pm$ 1. 08	3.43 $\pm$ 1. 89	0.001
Post-48 hrs.Mean $\pm$ SD	1.65 $\pm$ 1. 31	3.01 $\pm$ 1. 37	0.043
Post-1 Wk.Mean $\pm$ SD	1.21 $\pm$ 1. 21	1.73 $\pm$ 1. 64	0.062

VAS Back Pain & Resting Mean $\pm$ SD			
Pre-Operative, Mean $\pm$ SD	0.00	0.00	0.043
Post-Operative, Mean $\pm$ SD	6.9 $\pm$ 1. 42	7.1 $\pm$ 2. 41	0.001
Post-12 hrs.Mean $\pm$ SD	6.92 $\pm$ 1. 16	7.97 $\pm$ 2. 46	0.001
Post-24 hrs.Mean $\pm$ SD	5.24 $\pm$ 1. 08	3.43 $\pm$ 1. 89	0.001
Post-48 hrs.Mean $\pm$ SD	4.65 $\pm$ 1. 31	3.01 $\pm$ 1. 37	0.253
Post-1 Wk.Mean $\pm$ SD	2.21 $\pm$ 1. 21	2.73 $\pm$ 1. 64	0.062
VAS Back Pain & Activation Mean $\pm$ SD			
Pre-Operative, Mean $\pm$ SD	0.00	0.00	0.04
Post-Operative, Mean $\pm$ SD	6.9 $\pm$ 1. 42	7.98 $\pm$ 2. 41	0.001
Post-12 hrs.Mean $\pm$ SD	6.92 $\pm$ 1. 16	7.87 $\pm$ 2. 46	0.001
Post-24 hrs.Mean $\pm$ SD	5.24 $\pm$ 1. 08	6.43 $\pm$ 1. 19	0.001
Post-48 hrs.Mean $\pm$ SD	4.65 $\pm$ 1. 25	5.88 $\pm$ 1. 87	0.253
Post-1 Wk.Mean $\pm$ SD	2.11 $\pm$ 1. 24	2.93 $\pm$ 1. 65	0.062
Quality of Sleep Mean $\pm$ SD			
Pre-Operative, Mean $\pm$ SD	4. 22 $\pm$ 1.44	4. 63 $\pm$ 1.93	0.05
Post-Operative, Mean $\pm$ SD	5.9 $\pm$ 1. 42	5.28 $\pm$ 2. 41	0.001
Post-12 hrs.Mean $\pm$ SD	6.92 $\pm$ 1. 26	6.07 $\pm$ 2. 46	0.001
Post-24 hrs.Mean $\pm$ SD	6.54 $\pm$ 1. 18	6.13 $\pm$ 1. 19	0.001
Post-48 hrs.Mean $\pm$ SD	6.65 $\pm$ 1. 28	6.08 $\pm$ 1. 83	0.053
Post-1 Wk.Mean $\pm$ SD	6.81 $\pm$ 1. 21	6.63 $\pm$ 1. 62	0.062

Table 12B: Performance state with assistance

Variables (Activity)	ESPB (Group-A) n=45	LAWI(Group-B) n=45	Intergroup P Value
Ability to turn on bed,			
Pre-Operative,	43	44	0.899
Post-Operative,	21	18	0.001
Post-12 hrs.	23	20	0.001
Post-24 hrs.	34	30	0.001
Post-48 hrs.	44	41	0.353
Post-1 Wk.	45	44	0.362
Ability to Sit			
Pre-Operative,	43	44	0.897
Post-Operative,	23	16	0.001
Post-12 hrs.	27	20	0.001
Post-24 hrs.	31	28	0.001
Post-48 hrs.	43	40	0.353
Post-1 Wk.	45	44	0.362
Ability to get out bed			
Pre-Operative,	42	43	0.897
Post-Operative,	19	14	0.001
Post-12 hrs.	25	19	0.001
Post-24 hrs.	31	26	0.001
Post-48 hrs.	43	39	0.353
Post-1 Wk.	45	43	0.362
Ability to Stand			
Pre-Operative,	43	44	0.897
Post-Operative,	23	16	0.001
Post-12 hrs.	27	20	0.001
Post-24 hrs.	34	29	0.001
Post-48 hrs.	43	40	0.353
Post-1 Wk.	45	44	0.362
Ability to use Rest-Room			
Pre-Operative,	42	43	0.897
Post-Operative,	20	16	0.001
Post-12 hrs.	22	18	0.001
Post-24 hrs.	30	29	0.001
Post-48 hrs.	43	41	0.353

Post-1 Wk.	45	44	0.362
Ability to Walk with Walker			
Pre-Operative,	38	39	0.897
Post-Operative,	17	14	0.001
Post-12 hrs.	18	17	0.001
Post-24 hrs.	33	29	0.001
Post-48 hrs.	40	39	0.353
Post-1 Wk.	43	41	0.362
Ability to Walk by self			
Pre-Operative,	35	33	0.897
Post-Operative,	0	0	0.001
Post-12 hrs.	0	0	0.001
Post-24 hrs.	1	0	0.001
Post-48 hrs.	20	17	0.353
Post-1 Wk.	36	34	0.362
Ability to Walk above 100 meter			
Pre-Operative,	11	12	0.897
Post-Operative,	0	0	0.001
Post-12 hrs.	0	0	0.001
Post-24 hrs.	0	0	0.001
Post-48 hrs.	10	0	0.353
Post-1 Wk.	19	16	0.362

Table 13: Performance state by self

Variables (Activity)	ESPB (Group-A) n=45	LAWI(Group-B) n=45	Intergroup P Value
Ability to turn on bed,			
Pre-Operative,	41	40	0.899
Post-Operative,	0	0	0.001
Post-12 hrs.	0	0	0.001
Post-24 hrs.	1	0	0.001
Post-48 hrs.	16	12	0.353
Post-1 Wk.	21	18	0.362
Ability to Sit			
Pre-Operative,	40	38	0.897
Post-Operative,	0	0	0.001
Post-12 hrs.	0	0	0.001
Post-24 hrs.	0	0	0.001
Post-48 hrs.	10	8	0.353
Post-1 Wk.	21	18	0.362
Ability to get out bed			
Pre-Operative,	42	43	0.897
Post-Operative,	0	0	0.001
Post-12 hrs.	0	0	0.001
Post-24 hrs.	9	6	0.001
Post-48 hrs.	13	10	0.353
Post-1 Wk.	26	21	0.362
Ability to Stand			
Pre-Operative,	38	39	0.897
Post-Operative,	0	0	0.001
Post-12 hrs.	0	20	0.001
Post-24 hrs.	0	29	0.001
Post-48 hrs.	13	10	0.353
Post-1 Wk.	15	14	0.362
Ability to use Restroom			
Pre-Operative,	37	38	0.897
Post-Operative,	0	0	0.001
Post-12 hrs.	0	0	0.001

Post-24 hrs.	0	0	0.001
Post-48 hrs.	8	6	0.353
Post-1 Wk.	14	12	0.362
Ability to Walk with Walker			
Pre-Operative,	34	35	0.897
Post-Operative,	0	0	0.00
Post-12 hrs.	0	0	0.00
Post-24 hrs.	0	0	0.00
Post-48 hrs.	2	2	0.353
Post-1 Wk.	12	11	0.362
Ability to Walk by self			
Pre-Operative,	30	29	0.897
Post-Operative,	0	0	0.001
Post-12 hrs.	0	0	0.001
Post-24 hrs.	0	0	0.001
Post-48 hrs.	6	4	0.353
Post-1 Wk.	9	7	0.362
Ability to Walk above 100 meter			
Pre-Operative,	11	12	0.897
Post-Operative,	0	0	0.001
Post-12 hrs.	0	0	0.001
Post-24 hrs.	0	0	0.001
Post-48 hrs.	1	1	0.353
Post-1 Wk.	7	5	0.362

The VAS scores for pain at the surgical site during resting and movement were lower in the group-A at H0 and at 12, 24, and 48 hours. The intensity of pain at posterior surgical sites was also affected. Group A was lower than that in the group B (2.09 ± 1.07 vs. 2.73 ± 1.38 ; $P = 0.032$).

The complication rates did not differ significantly between the two groups. During 1 week of hospitalization, no differences in sleep quality were observed ($P = 0.838$ the first day, $P = 0.255$ the second night, and $P = 0.783$ at postoperative week 1). The patients of Gr-A were more satisfied with their pain control management on the postoperative first day (7.0 ± 1.2 vs. 6.0 ± 1.4 ; $P = 0.003$) and at 1 week (8.1 ± 1.6 vs. 7.0 ± 1.8 ; $P = 0.010$). On the second postoperative day, patients of group A were more satisfied with their pain management than those in the group B (7.2 ± 1.1 vs. 6.7 ± 1.5), but the difference was not statistically significant ($P = 0.092$). The postoperative data regarding activity with assistance showed that patients of Gr.A were more capable of turning in bed, sitting, standing, and using the restroom, and walked sooner than those in the group -B. Patients in the group-A also performed the tasks above without assistance sooner than those in the group-B. Reviewed all patients' medical records for 3 months after the operation. There were no reports of complications related to the Gr.A such as local fluid collection, infections, or skin redness at the insertion site. In this study the sample size was very small, hence,

large sample size with multicentric studies on rural population are required to established the ESPB method with the combination of ropivacaine (0.375%) with 1 $\mu\text{g/kg}$ dexmedetomidine.

Discussion

Thoracolumbar spine surgery is one of the most painful surgical procedures. Causes of perioperative pain in spine surgery are iatrogenic mechanical damage, soft-tissue retraction, partial devascularization and handling of bones, ligaments, muscles, intervertebral discs, and facet joints, all of which are innervated by dorsal rami of spinal nerves. In this context, multimodal analgesia has been recommended for effective postoperative recovery and early mobilization.[17,18, 22].

To enhance the multimodal approach and opioid-sparing, several local anesthesia (LA) administration routes have been evaluated: intravenous, infiltration (wound), and regional (paravertebral, epidural, and spinal).[19,20, 23, 24]. Local infiltration at the incision site has been used for spine surgery for many years. A systematic review of trials comparing wound infiltration with local anesthetics versus placebo revealed a small or modest reduction in pain intensity immediately after surgery and a minor reduction in opioid consumption with questionable clinical significance [25].

Relieving postoperative pain has become a major component in the care of patients who have undergone lumbosacral fusion [18-26].

A study revealed that postoperative pain was exacerbated by increasing inflammatory factors in the surrounding tissue and the catecholamine level, resulting in insufficient wound perfusion and circulation. Wound infiltration with local anesthetics alleviates pain and promotes the wound-healing process by increasing perfusion and oxygenation at the surgical site [27].

Another hypothesis is that local continuous anesthesia infiltration reduces postoperative pain via modification of the central nervous system (CNS) [11]. Peripheral tissue damage triggered two types of CNS activation pathway. The first pathway, central sensitization, was activated by nociceptive afferent input due to operative tissue damage. This nociceptive stimulation lead to over-activation of spinal cord neurons. This hyper-activation results in an increase in the postoperative pain response [28-31]. In a study, LA infiltration had taken at the incision site as one group to compare with ESPB Group. Regarding epidural analgesia, placing a preoperative epidural catheter may interfere with spine surgery [32]. Furthermore, surgery can damage the dura mater, leading to a risk of intrathecal penetration of local anesthetics. Recently, lumbar ESPB has been proposed as an alternative to other regional techniques for analgesia in spine surgeries [32-36, 55]. By blocking the ventral and dorsal rami of the spinal nerves, ESPB has been successfully used for analgesia following various procedures including cardiac surgery, thoracic surgery, breast surgery, percutaneous nephrolithotomy, ventral hernia repair, cesarean section, bariatric surgery, cholecystectomy, and hip surgery [37-43, 56-58].

The USG-guided ESPB rapidly gained popularity because of the ease of sonographic identification of landmarks and a lower complication rate. Furthermore, reducing opioid requirements during the perioperative period is among the current goals of enhanced recovery programs. ESPB plays an important role in reducing opioid requirements.[39,44, 54-59]

The present study, compared the ESPB with local anesthetic wound infiltration (LAWI) at the incision site for intraoperative hemodynamic stability and effective postoperative analgesia following lumbar spine surgery. Demographic data and duration of surgeries were comparable in both the groups. At incision, the change in mean pulse rate from the baseline pulse rate was higher in Group-B as compared to Group A. Hence, dexmedetomidine infusion was started in Group B to maintain hemodynamic, as a result of which Group B showed a constant decrease in pulse rate.

A study revealed that the mechanism of action of dexmedetomidine included activation of the receptors in the brain and spinal cord inhibits neuronal firing, causing hypotension, bradycardia, sedation, and analgesia [45].

In Group A, the pulse rate was stable throughout the surgery and the requirement of intraoperative dexmedetomidine was significantly lower as compared to Group B. It was also observed a significant decrease in MAP in Group A as compared to Group B.

A study noted similar observations in their study that bilateral ultrasound ESPB provided better intraoperative and postoperative heart rate and blood pressure stability with better impact on patient satisfaction [46].

A recent meta-analysis which summarized all the published randomized controlled trials (RCTs) on ESPB and demonstrated that ESPB was a good choice for pain relief after surgery, not only in breast and thoracic surgeries but in orthopedics and abdominal procedures [47].

A systematic review and meta-analysis which included six RCTs with 360 patients of postoperative analgesic efficacy of the erector spinae block in patients undergoing lumbar spinal surgery, concluded as the ESPB was a safe and effective mode of postoperative analgesia similar to our study [48]. This study also shown the similar observations in our study as the total number of analgesic doses required in the first 24 h postsurgery in Group A were significantly less than those required in Group B. Intraoperative hemodynamic stability also plays a role in the good surgical field and less blood loss. In this study, the surgical field was better in Group A as compared to Group B and so was surgeon's satisfaction level higher in Group A than in Group B.

The ESP block can provide regional analgesia for a wide range of surgeries in the anterior, posterior, and lateral thoracic and abdominal areas, as well as for the treatment of acute and chronic pain disorders [49]. The erector spinae plane (ESP) block is a paraspinal fascial plane block in which a needle is inserted between the erector spinae muscle and the transverse processes. A local anesthetic is delivered here, namely to the dorsal and ventral rami of the thoracic and abdomen spinal nerves.

This randomized prospective study has shown that analgesia achieved post-operatively was superior when erector spinae block was given compared to surgical incision site infiltration. In this study, combination of ropivacaine (0.375%) with 1 µg/kg dexmedetomidine was used as it is cardio-stable and minimally neurotoxic. In this present study, it was compared, 20ml of combination of ropivacaine

(0.375%) with 1 µg/kg dexmedetomidine for erector spinae block on either side or combination of ropivacaine (0.375%) with 1 µg/kg dexmedetomidine for surgical site-local anesthetic would infiltration in spine. The longevity of analgesia was prolonged by using combination of ropivacaine (0.375%) with 1 µg/kg dexmedetomidine for erector spinae block as compared to LAWI. Rescue analgesic requirement was lower in patients in whom erector spinae block was given.

A prospective randomized controlled experiment was conducted to assess the effect of bilateral ultrasound-guided erector spinae blocks on postoperative pain and opioid use following lumbar spine surgery. The primary endpoint was the total amount of morphine used during the operation and within the first 24 hours post-operatively. Secondary outcomes included the time between the first request for rescue analgesia and the occurrence of adverse events. The ESPB group consumed considerably less morphine during the intraoperative and first 24 postoperative hours than the control group ($P < 0.001$) [50].

This present study concluded that bilateral ultrasound guided-ESPB is an effective strategy for pain management during lumbar spine operations.

A study compared bilateral ultrasound-guided erector spinae plane block (ESPB) with surgical site infiltration for postoperative analgesia in lumbar spinal fusion surgery. The study concluded as that, compared to wound infiltration, bilateral ultrasound guided ESPB reduced short-term opioid consumption in patients after lumbar spinal fusion surgery, aligning with the findings of our study. Additionally, they found that patients in the ESPB group had significantly lower cumulative doses of demanded PCA boluses [51].

A similar retrospective study was conducted to evaluate the effectiveness of the erector spinae block for lumbar spine surgery. They found that the Numeric rating scale pain scores in the erector spinae group (E group) were significantly lower at 1, 2, 4, 6, 12, and 24 hours postsurgery, as well as on the morning of postoperative day 2, compared to the general anaesthesia group (G group), with all time points showing $p < 0.05$. Additionally, the amount of fentanyl administered as a bolus (40 µg) in the E group was less than that in the G group (100 µg) during the first 24 hours after surgery ($p < 0.05$). The study also concluded as that the erector spinae plane block provided effective postoperative analgesia for 24 hours in patients undergoing lumbar spine surgeries [52].

A study compared the efficacy of the erector spinae plane block (Group II) and peritubal infiltration of levobupivacaine (Group I) for postoperative

analgesia following percutaneous nephrolithotomy. The study found that patients who received the erector spinae block had a significantly longer time to first rescue analgesic request. Additionally, VAS scores (both at rest and during movement) at the eight- and twelve-hour marks were significantly lower in Group II ($P < 0.05$). Analgesic demand was also lower in Group II (2.97 ± 0.49 vs. 1.00 ± 1.05), with total analgesic consumption in the first 24 hours being lower in Group II (148.33 ± 24.51 mg vs. 51.92 ± 45.78 mg) [53]. The present study results on VAS score, NRS score were similar with the above study.

There were a few limitations in this study.

Selected only patients belong to patients of ASA I and ASA II.

Sample size was very small.

Further research is required with large sample size to evaluate the efficacy of erector spinae block over local wound site infiltration as there are limited human clinical trials in India, particularly in rural population.

Conclusion

USG-guided bilateral ESP block for spine surgery was an excellent component of multimodal analgesia, maintaining hemodynamic intraoperatively without any additional drug requirement, reducing blood loss, postoperative pain, and total analgesic consumption and shorten hospital stay, thus making it a safe and effective approach. Ropivacaine and dexmedetomidine could be considered as the best currently available drug combination for ESPB.

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